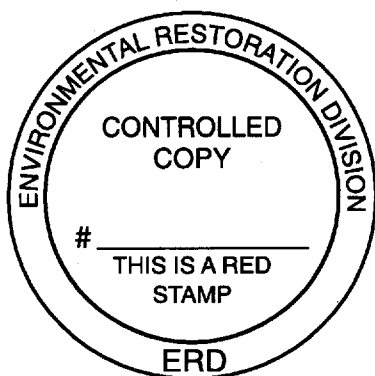


LLNL Environmental Restoration Division (ERD)
Standard Operating Procedure (SOP)

**ERD SOP 4.8: Calibration/Verification and Maintenance of
Measuring and Test Equipment (M&TE)—Revision: 5**



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1.0 PURPOSE

The purpose of this SOP is to ensure accurate and consistent field chemistry, water level, and organic vapor measurements using measuring and test equipment (M&TE) such as (1) pH meter, (2) conductivity meter, (3) dissolved oxygen meter and probe, (4) radiation survey meter, (5) water-level indicator, (6) organic vapor meter, and (7) explosimeter.

2.0 APPLICABILITY

This procedure is applicable to all M&TE used by ERD for the collection of field data.

3.0 REFERENCES

Not applicable.

4.0 DEFINITIONS

See SOP Glossary.

Procedure No. ERD SOP-4.8	Revision Number 5	Page 2 of 10
------------------------------	----------------------	--------------

5.0 RESPONSIBILITIES

5.1 Division Leader

The Division Leader's responsibility is to ensure that all activities performed by ERD at the Livermore Site and Site 300 are performed safely and comply with all pertinent regulations and procedures, and provide the necessary equipment and resources to accomplish the tasks described in this procedure.

5.2 Field Personnel

Field personnel are responsible for the calibration, calibration verification and maintenance of the M&TE in accordance to this procedure and documented maintenance and calibration schedules.

6.0 PROCEDURE

6.1 Critical and Noncritical M&TE

6.1.1 Critical M&TE is defined as:

- M&TE whose measurement accuracy is critical to the validity of programmatic results.
- M&TE whose measurement accuracy is critical to monitoring or controlling safe conditions to prevent hazards to personnel or the environment.
- M&TE used for the accountability of nuclear material.
- M&TE used to determine acceptability of the physical, mechanical, electrical, radiological, environmental, and chemical characteristics of Graded Approach Category 1 & 2 structures, systems, and components. (Category 1: failure of the structure, system, or component may cause death or serious injury or illness to a member of the public, or may cause severe damage to the environment beyond the boundaries of the Laboratory, or require major cleanup. Category 2: Failure of the structure, system, or component may cause minor injury, illness, irritation, or annoyance to a member of the public, may cause death or serious injury or illness to a Laboratory worker, may cause damage to the environment within the Laboratory boundaries, requiring limited cleanup).
- M&TE used to calibrate critical M&TE as defined above.

6.1.2 Noncritical M&TE is any M&TE used to collect data that does not meet the critical M&TE definition.

6.1.3 ERD critical M&TE is listed in Attachment A.

6.1.4 When new equipment is purchased, the ERD QAIC must be informed so the equipment can be added to the ERD M&TE list. The new equipment's intended use must be evaluated to determine if the M&TE is critical. A "LLNL Calibration Program" sticker must be affixed to all critical M&TE.

Procedure No. ERD SOP-4.8	Revision Number 5	Page 3 of 10
------------------------------	----------------------	--------------

6.2 Documentation Requirements

- 6.2.1 Each piece of critical M&TE should have its own calibration/maintenance logbook. The instrument and serial number should be clearly identified. The following information should be documented in the calibration/maintenance logbook:
- A. Date of entry and initials of the individual recording the entry.
 - B. Results of the calibration or calibration verification.
 - C. Traceability information on the standards and method used for calibration or verification, including standard preparation details.
 - D. Maintenance performed.
 - E. Operator comments.
 - F. The calibration or verification status (i.e., “calibrated” or “not calibrated”).
- 6.2.2 The following information should be documented in the field sampling, drilling or treatment facility logbook so that the calibration information may be referenced:
- A. Calibration, verification, or maintenance activity.
 - B. Date of entry.
 - C. Instrument name.
 - D. Serial number.
 - E. Operator comments.
- 6.2.3 When appropriate, calibration status shall also be indicated by placing a label on the instrument. The label should contain the calibrator’s initials, calibration date, and next calibration due date.
- 6.2.4 Store the manufacturer’s owner/operator manual with the M&TE.

6.3 Standard Requirements

- 6.3.1 Standards used for critical M&TE calibration and calibration verification shall be traceable to the National Institute of Standards and Technology (NIST) or other recognized national standards whenever possible. If NIST standards do not exist, the reference standards used should be supported by certificates, reports, or data sheets. All traceability documentation should be kept with the instruments and attached in the calibration/maintenance logbook.
- 6.3.2 Store standards in an appropriate place so as not to compromise integrity. If the standards do not come with storage and handling guidance to maintain the required accuracy and characteristics of the standard, QC Chemist should be consulted.
- 6.3.3 The standards expiration date should be clearly marked. Do not use expired standards. Dispose all expired standards properly through LLNL Hazardous Waste Management Division.

Procedure No. ERD SOP-4.8	Revision Number 5	Page 4 of 10
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6.4 Calibration Nonconformances

- 6.4.1 Any M&TE found damaged or malfunctioning should be labeled as such and removed from service immediately. The condition shall be documented in the calibration/maintenance logbook and the appropriate steps should be taken to restore the M&TE or a back-up unit should be used.
- 6.4.2 If any M&TE is found to be out of calibration during the collection of measurement data, the condition shall be documented on a Quality Improvement form (QIF). The deficiency shall be evaluated and corrective action shall be taken. The prospective users and recipients of the associated measurement data shall be notified of the results of the QIF. Acceptance of measurements made with uncalibrated M&TE needs to be reviewed by the QAIC and justification for acceptance documented. Instructions for filing a QIF can be found in SOP 4.12, "Quality Improvement Forms (QIFs)."

6.5 Choosing M&TE

- 6.5.1 General selection criteria for choosing M&TE are given below:
 - A. M&TE should be capable of attaining the appropriate range, precision, and accuracy necessary of the intended measurement. (Permits may include required criteria). M&TE range, precision, and accuracy information should be obtained from the manufacturer.
 - B. Instruments should be made by a well-known, reputable company. Individuals (chemists, geochemists, experienced field personnel) who have used the instrument in the past should be consulted.
 - C. Do not use instruments that are fragile or sensitive to water, heat, or cold. Field instruments should be rugged and constructed specifically for field work.

6.6 M&TE Calibration and Verification Procedures

6.6.1 pH Meter

pH meters require on-site calibration.

At a given temperature the intensity of the acidic or basic character of a solution is indicated by pH or hydrogen ion activity. Since pH is dependent upon temperature, all meters must have a temperature measurement and compensation mode. Otherwise, the calibration should be made at the same temperature ($\pm 2^{\circ}\text{C}$) as the samples.

A. Calibration Frequency:

The pH meter is calibrated a minimum of once a day just prior to the day's first measurement using traceable, fresh buffer solutions of pH 4, 7, or 10. Buffer solutions should have expiration dates stamped on the container. Expired buffers are not to be used.

B. Calibration Procedure:

Procedure No. ERD SOP-4.8	Revision Number 5	Page 5 of 10
------------------------------	----------------------	--------------

The pH meter manufacturer's instructions will be followed when calibrating the instrument.

C. Calibration Verification:

The calibration can be accepted if the measured pH of the pH verification buffer is within one tenth (i.e., $\text{pH} = 7.0 \pm 0.1$). The verification is performed initially after the two-point calibration.

If the measured pH falls outside that range, try one or all of the following:

1. Double check the temperature of the buffer. Although small, temperature does affect the pH of the solution. The buffer is only at pH 7.0 when it is exactly 25.0°C. An extremely hot or cold solution could make the measurement fall outside the range of acceptability. Try heating or cooling buffers to closer to 25° and recalibrate.
2. Look for indication that there is a problem with the meter or probe. Many meters have an indicator on the screen which displays when there is a potential problem.
3. Consult the trouble shooting section of the equipment manual or locate a back-up unit.
4. Replace all buffers.
5. Replace probe filling solution.

6.6.2 pH Paper

A. Calibration Frequency:

None required.

B. Calibration Procedure:

None required.

C. Calibration Verification:

Each new lot of pH paper should be checked against 3 pH buffer solutions (high, low, and medium range), to check range and accuracy of the paper. The pH paper lot check should be documented in a logbook kept for this purpose. Use appropriate range of pH paper.

6.6.3 Conductivity Meter

Conductivity is a numerical expression of the ability of an aqueous solution to transmit an electrical current. This ability depends on the presence of ions, therefore, high conductivity will be observed when the pH is very high or very low. Conductivity is also temperature dependent, so all meters must have a temperature compensation mode. Otherwise, the calibration verification should be made at the same temperature ($\pm 2^\circ\text{C}$) as the samples.

A. Calibration Frequency:

Procedure No. ERD SOP-4.8	Revision Number 5	Page 6 of 10
------------------------------	----------------------	--------------

Generally, conductivity meters are initially factory calibrated. If the meter has not been factory calibrated, it should be calibrated prior to each day's use.

B. Calibration Procedure:

Calibration will be performed at the factory or as directed by the instruments operating instructions.

C. Calibration Verification:

The calibration is verified prior to each day's use per the operating instructions.

6.6.4 Dissolved Oxygen (DO) Meter

A. Calibration Frequency:

Generally, DO meters are initially factory calibrated. If the meter has not been factory calibrated, it should be calibrated prior to each day's use.

B. Calibration Procedure:

Calibration will be performed at the factory or as directed by the instruments operating instructions.

C. Calibration Verification:

The calibration is verified prior to each day's use per the operating instructions.

6.6.5 Water-Level Indicator

Calibration is not required.

6.6.6 Thermo Hydrocarbon Analyzer (THA)

THAs must be calibrated on site.

A. Calibration Frequency:

Thermo Hydrocarbon Analyzers (THAs), are to be calibrated once a day or whenever the calibration verification indicates the instrument is no longer calibrated.

B. Calibration Procedure:

Calibrate THAs using three (low, medium, and high) calibration standards that bracket the range of the instrument.

C. Calibration Verification:

Verify the day's calibration before use or when the instrument has been idle. Use a 1 mid-range calibration standard.

Procedure No. ERD SOP-4.8	Revision Number 5	Page 7 of 10
------------------------------	----------------------	--------------

6.6.7 Organic Vapor Analyzer (OVA)

A. Calibration Frequency:

Calibration frequency is every 6 months. Submit OVA for off-site calibration before expiration date indicated by the calibration sticker on the equipment. Do not use expired equipment.

B. Calibration Procedure:

OVAs are calibrated by an off-site organization.

C. Calibration Verification:

Verify the calibration before use with 1 mid-range calibration standard.

6.6.8 Explosimeters or Lower Explosive Limit (LEL) Meters

Explosimeters are used to monitor ambient conditions for oxygen content.

A. Calibration Frequency:

Calibration frequency is determined by Hazards Control. Calibration expiration date is indicated on the calibration sticker located on the instrument. Return to Hazards Control before expiration date. Do not use expired equipment.

B. Calibration Procedure:

Explosimeters are calibrated and maintained by the Hazards Control Department of LLNL

C. Calibration Verification:

None required.

6.6.9 Flow meters

Flow meters are used for general purpose routine sampling.

A. Calibration Frequency:

Flow meters are factory calibrated.

B. Calibration Procedure:

Calibration is to be performed at the factory.

C. Calibration Verification:

Flow meters should be periodically checked against a similar flow meter for accuracy and sent to the factory for re-calibration as necessary.

Procedure No. ERD SOP-4.8	Revision Number 5	Page 8 of 10
------------------------------	----------------------	--------------

6.7 Maintenance

- 6.7.1 Maintenance is to be performed each day the M&TE is used. Perform maintenance as described in the equipment operating instructions. Maintenance may include refreshing the electrolyte solution in pH and DO probes, checking DO probe membranes for damage, replacing, or charging batteries as needed, checking operation of all instrument displays, etc.
- 6.7.2 Replace or repair M&TE as necessary.
- 6.7.3 Decontaminate M&TE per SOP 4.5, “General Equipment Decontamination.”
- 6.7.4 Maintain M&TE storage area and store M&TE properly per manufacturer instructions to prevent damage to the M&TE.

7.0 QA RECORDS

- 7.1 M&TE Calibration and Maintenance Logbooks
- 7.2 Field Sampling Logbooks
- 7.3 Field Sampling Sheets
- 7.4 Treatment Facility Logbooks
- 7.5 Completed QIFs
- 7.6 QIF Logbook
- 7.7 Standard traceability documentation

8.0 ATTACHMENT

Attachment A—ERD Critical Measuring and Test Equipment List

Procedure No. ERD SOP-4.8	Revision Number 5	Page 9 of 10
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Attachment A

ERD Critical Measuring and Test Equipment List

Attachment A. ERD critical measurement and test equipment list.

Item name	DOE no.	Serial no.	Model no.	Cal. freq.	Range	Min. detect. limit	Accuracy	Custodian	Location	Calibrator
Gastech Inc. LEL Meter	354	A1559	1177	3 mo	0–100%	NA	0.5% of range	J. Greci	Liv/B438	Haz. Control
Gastech Inc. LEL Meter	231	A1678	1177	3 mo	0–100%	NA	0.5% of range	J. Ulrech	Liv/T4387 drilling	Haz. Control
Gastech Inc. LEL/O2 meter	174	B2731	1214	3 mo	0–100%	NA	0.5% of range	J. Greci	Liv/B438	Haz. Control
Gastech Inc. LEL Meter	NA	A1674	1177	3 mo	0–100%	NA	0.5% of range		B406/EO Experiment	Haz. Control
Foxbrough OVA/FID Organic Vapor Analyzer	5199134	51556	OVA-128	6 mo	0–10,000	0.2 ppm	20%	D. White	Liv/B406	Southern Cross
Foxbrough OVA/FID Organic Vapor Analyzer	8021616	A52245	OVA-128	6 mo	0–10,000	0.2 ppm	20%	J. Cunningham	Site 300/B834	Southern Cross
Foxbrough OVA/FID Organic Vapor Analyzer	5226403	41126	OVA-128	6 mo	0–10,000	0.2 ppm	20%	D. Graves	Site 300/CGSA	Southern Cross
Foxbrough OVA/FID Organic Vapor Analyzer	5226410	41125	OVA-128	6 mo	0–10,000	0.2 ppm	20%	B. Kidd	Liv/B472	Southern Cross
Thermo Hydrocarbon Analyzer	8032728	68053380297	680HVM	before use	0–10,000	0.5 ppm	10%	B. Johnson	Liv/B438	user
Thermo Hydrocarbon Analyzer	8032858	51LT53875297	51	before use	0–10,000		0.1 ppm	S. Martins	B241	user
Thermo Hydrocarbon Analyzer	8041546	68055012306	680HVM	before use	0–10,000	0.5 ppm	10%	B. Johnson	Liv/B438	user
Thermo Hydrocarbon Analyzer	8042826	68055028305	680HVM	before use	0–10,000	0.5 ppm	10%	B. Johnson	Liv/B438	user
Thermo Hydrocarbon Analyzer	8042833	68055029305	680HVM	before use	0–10,000	0.5 ppm	10%	B. Johnson	Liv/B438	user
Thermo Environmental Instruments Inc. OVM/PID	NA	580U56161306	580B	before use	0–10,000	NA	0.1 ppm	B. Johnson	Liv/B438	user
Thermo Environmental Instruments Inc. OVM/PID	NA	580U48090279	580B	before use	0–10,000	NA	0.1 ppm	G. Santucci	Site 300/B843	user
Thermo Environmental Instruments Inc. OVM/PID	NA	580U38477258	580B	before use	0–10,000	NA	0.1 ppm	J. Greci	Site 300	user
Thermo Environmental Instruments Inc. OVM/PID	NA	580U56162306	580B	before use	0–10,000	NA	0.1 ppm	G. Santucci	Site 300/B843	user
Thermo Environmental Instruments Inc. OVM/PID	NA	56724-309	580EZ	before use	0-10,000	NA	0.1 ppm	J. Ulrech	Liv/T4387 drilling	user
Thermo Environmental Instruments Inc. OVM/PID	NA	56725-342	580EZ	before use	0-10,000	NA	0.1 ppm	J. Ulrech	Liv/T4387 drilling	user
Thermo Environmental Instruments Inc. OVM/PID	NA	580U33854477	580B	before use	0-10,000	NA	0.1 ppm	J. Ulrech	Liv/T4387 drilling	user
Thermo Environmental Instruments Inc. OVM/PID	NA	580U39794261	580B	before use	0-10,000	NA	0.1 ppm	B. Johnson	Liv/B438	user
Thermo Environmental Instruments Inc. OVM/PID	NA	580U38476258	580B	before use	0-10,000	NA	0.1 ppm	J. Ulrech	Liv/T4387 drilling	user
RKI Sample-Drawing Gas Detector Assemblies	NA	NA	35-3000RK	3 mo	NA	NA		B. Kidd	5475 CRD-1	Alarm Shop

Notes:

Cal. freq. = Calibration frequency.

CGSA = Central General Services Area.

Cond. Temp. = Conductivity temperature.

EO = Electro-osmosis.

Haz. = Hazard.

Inc. = Incorporated.

LEL = Lower explosive limit.

Liv = Livermore.

Min. detect. = Minimum detection.

mo = Month(s)

NA = Not applicable or not available.

no. = Number.

OVA/FID = Organic vapor analyzer/Flame ionization detector.

OVM/PID = Organic vapor monitor/Photoionization detector.

ppm = Parts per million.

ppm = Parts per million.

Procedure No. ERD SOP-4.8	Revision Number 5	Page 10 of 10
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